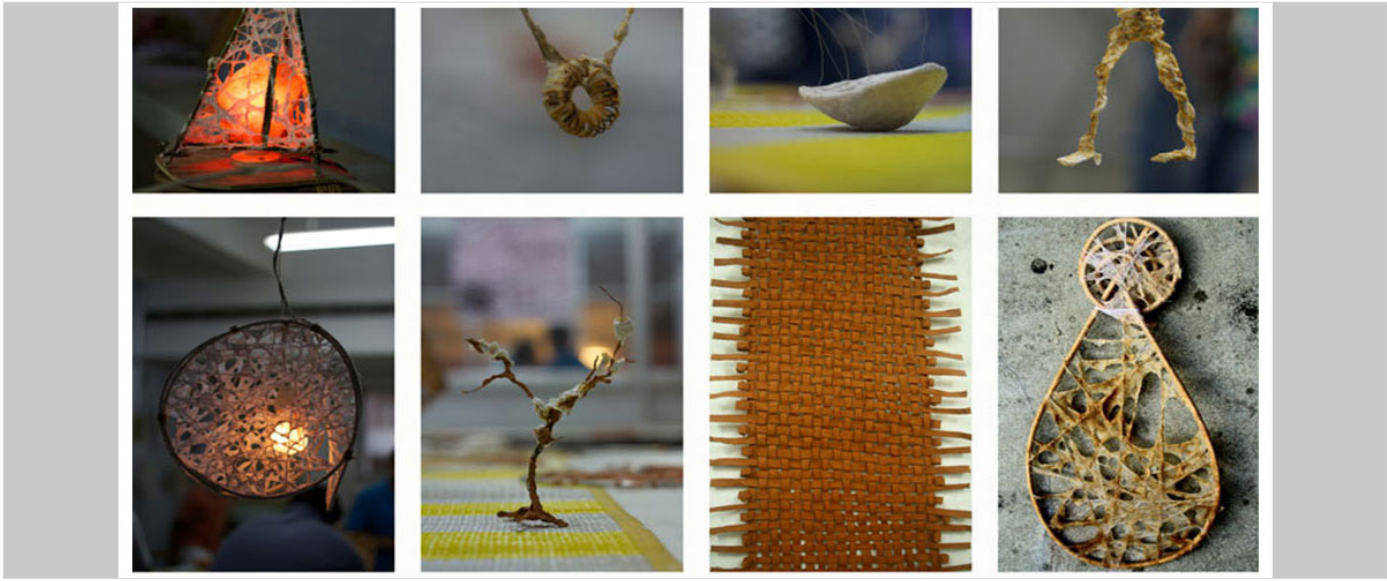
Design Course

Handmade Paper Making

Understanding the Art by Creative Exploration

by
Mr. Anupam Chakraborty
DoD, IIT Guwahati



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Introduction

Creative Exploration in Handmade Papermaking:

Methods and Techniques:
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Introduction:
Unlike the touch and feel of industrially produced paper, handmade paper has the touch and feel of being hand-crafted. Its look and raw feel, texture and economic cost of production has drawn interest amongst various users including artists / designers/ packaging experts for use in a variety of creative applications.

The art of making handmade paper by one's own self offers immense creative possibilities in exploring a variety of easily accessible natural fibers from recyclable waste, plants, flowers, leaves etc. How is it made? What are the simple facilities required for making handmade paper? How is it produced in an inexpensive manner in the studio? Can it be used in creating 3 dimensional sculptural forms?

This course work comprises of Detailed notes, video and photo documentation of Creative explorations in making handmade paper; Techniques and methods; Exhibits of students work and interview of the artist.

Aim:
This course has been developed for a person interested and self motivated in exploring the creative possibilities of understanding the art of handmade paper making in a simple 'do-it yourself ' approach encouraging learning by doing. It presents the outcome of work of students of the Department of Design, IIT Guwahati who undertook a one week workshop under the guidance of Mr. Anupam Chakraborty, Director, Anupam Academy, Kolkata in December, 2011. It encourages analysis and discussions on the work done

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It aims to help visual artists, designers, painters, potters, graphic designers, sculptors or product designers or anybody interested in the creative arts in understanding the techniques and methods of the art of handmade paper making.

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About the Author

Anupam Chakraborty, Born in Kolkata, 1966.

Anupam Chakraborty, Founder and Creative Director, Nirupama Academy of Handmade Paper www.nirupama.org. He is a sole member of International Association of Hand Paper Makers and Paper Artists (IAPMA) from India.

He had done his Masters in Fine Arts (Graphic Arts), M. S. University, Vadodara and Post Graduate (Paper Making), Glasgow School of Art, Glasgow, UK. Few solo exhibitions exhibiting his art were held in Kolkata and Vadodara in India and Zurich in Switzerland in between 1997-2007. Also, his art has been showcased with number of other group exhibitions held in India and abroad.

Anupam Chakraborty has been involved in teaching his craft since 1995. Whereas, presently he is visiting faculty at - The Bhawanipur Gujarat Education Society College, Kolkata since 2006.

He had also conducted various workshops showcasing his art and teaching them to students. His works has been exhibited in India and abroad.

For more details on Anupam Chakraborty: Anupam Chakraborty
You can also check www.nirupama.org

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Chronology

A Brief Chronology of Paper Making:

BC 300	Writing surface made from residual silk floss in China.
AD 105	Papermaking method invented and developed by Ts'ai Lun, a eunuch attached to the Eastern Han court of the Chinese emperor Ho Ti. The material used was probably the bark of Mulberry tree, bamboo, rags, hemp and fish net. Chinese credited with all inventions like mould, screen and methods of papermaking, which later adopted by Western world.
300-1031	
300	Paper made in cases in Central Asia.
305 – 325	Paper produced in India at Gurukuls. But this process did not cultivated during that time.
500	Paper made in Korea.
610	Paper introduced to Japan. The Japanese learned from the Chinese and perfected papermaking into a high art form through centuries.
650	Paper made in Nepal.
700	Sizing (water resistance) introduced to papermaking using animal and vegetable substance (starch, rice flour) in Japan.
794	Paper made in Baghdad, Iraq.
850	Papermaking spreads from China via Nepal to India. In India papermakers were known as Kagaji and the place where paper produced was known as Kagajipura.

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900	Paper made in Cairo, Egypt.
1031	Paper recycled (Orient).
1150-1590	
1150	Paper introduced into Europe. First papermaking mill was established in Spain.
1189	Paper made at Hérault, France.
1280	Paper made at Fabriano, Italy.
1282	Invention of Watermark technique in Italy.
1337	Animal glue first used in Europe.
1345	Mohammed Bin Tughlak used handmade paper for the first time to produce notes.
1388	Paper made at Augsburg, Germany.
1400	Paper made at Marly, Switzerland.
1405–1550	Paper produced at various places in India namely, Kashmir, Shialkoat, Delhi, Patna, Ahmedabad, Aurangabad.
1428	Paper made at Gennap, Holland.
1450	Revolutionary demand for paper spurred by Gutenberg printing, Germany.

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1490	First paper mill in England, established by John Tate in Hertfordshire.
1491	Paper made in Poland.
1540	Paper made in Denmark.
1546	Paper made in Rumania.
1558	Paper made by John Spilman at Dartord, England.
1565	Paper made in Russia.
1570	Paper made by Sten Bille in Denmark.
1590	First paper mill in Scotland, established by Mungo Russell at Dalry.

1680-1950

1680	Invention of Hollander Beater revolutionizes papermaking process.
1690	First American paper mill established at Philadelphia by W. Rittenhouse.
1698	Paper made at Oslo, Norway.
1726	Paper made by William Bradford in New Jersey, USA.
1757	Adoption of "wove" mould screen in Europe from Far East countries.

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1765	Research work begun by Schäffer using vegetable fibres for papermaking.
1790	Invention of Hydraulic Press at Bramah, England.
1802	Paper made in Quebec, Canada.
1806	Invention of Fourdrinier machine.
1840	Invention of Wood Pulping machine by Keller, Germany.
1851	Invention of chemical wood pulping process.
1805–1900	Decline of hand papermaking mills due to rise of wood pulping mills.
1928	Revival of hand papermaking by Dard Hunter of America.
1946	Douglass Howell of America emerges as foremost authority in papermaking.
1950	Emergence of innovative art forms in hand papermaking.

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Natural Fibres

Botanical Name	Local Name	Parts Used
Abelmoschus Esculentus	Bhendi, Ran Turai	Outer bark of stem
Adansonia Digitata	Gorakh Amli	Inner bark
Agave Ameriana and varieties	Ghaipat, Ketki	Leaf fibre /waste /rope
Abulation Indica	Chakrabhend, Mudra tuthinar	Outer bark
Ananas Sativa	Ananas, Anasapandu	Fibre of leaves
Antiaris Taxicaria and varieties	Valkal Tree, Chanduka Karvat	Valkal or Inner bark
Bamboo	Bamboo, Vans, Bans	Culms, Basket, Mats
Boehmeria Nievea	China Grass of Rhea	bark fibre
Broussonetia Papyrifera	White Mulberry, Tut	Inner bark of young branch
Butia Frondosa and Varieties	Dhak, Palas or Chichara root	Inner bark of young branch
Calotropis Procera	Madder plant	Bast Fibre
Cannabis sativa / Indica	Hemp, ganga, bhang	Bast fibre of the plant
Corchorus capsularis	Jute of Bengal	Bast fibre, Toe, Gunny bag

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Careyas arborea	Kumhia, vVakumbha, Dudhippi	inner bark of tree
Crotalaria juncea and varieties	Sunn Hemp, Sona tag, Sunn, bags, etc.	Bast fibre,Ropes, Twins
Curcuma varieties	Halad, Harder, Amba, Ginger	Whole plant but not Coims
Cyperus Rotunds and varieties	Motha, Musta, Korai, Gandula, Mutha	Whole grass
Doemia Extensa	utarni	Outer bark
Daphne Cannabina and varieties	Nepal paper plant maha-deva	Inner bark and stem
Daphne bholua	Nepal paper plant lokta	Inner bark
Ficus varieties	Bar, vad, pimpal	inner bark of young branch
Girarddinia Heterophylla	Mothi, Kahajati, Agai	Bast fibre
Gossypium varieties	Kapas, cotton	Textiles, rags
Heliacteres isora	Murudsing	Bast fibre
Hibiscus varieties	Bhendi, ranbhendi, lal ambari, roselle	Stem bark
Ischoemum angustifolium	sabai, badhar grass	Grass, leaves, ropes
Lasiosphon erriocephalus	Rameta	Inner bark
Linum usitatissimum	Alasi, javas	bast fibre

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Musa varieties	Plantain, kela, chavai	Stem fibre
Oryza sativa	Rice straw, bhoosa	whole straw, not ropes
Pandanus odoratissimus	Kevda, ketki	Leaf fibre
Palae varieties	Palms	Leaves, stalks
Saccharum munja	Munj or sara grass	Leaves, ropes
Saccharum officinum	Sherdi, sakar, sugarcane, usa	Bagasse, leaves
Sansevierla zeylancia	Bow string hemp, nagpuri	Leaf fibre
Triticum Sativa	Wheat, straw, gehu	Whole straw, not tops
Typha Elephantine	Bul-rush, jungle bajri	Whole plant, not tops

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Paper Making

Techniques and Methods:

Different Techniques and Methods used in Handmade Papermaking from Plant Fibres are:

(a) Gathering
(b) Identification
(c) Preparation
- Application of Alkali
- The pH scale

(d) Beating
(e) Formation
(f) Pressing
(g) Drying
(h) Sizing

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(a) Gathering:
The hunt of interesting raw materials can be an adventure. Any natural material composed of cellulose and capable of being reduced to pulp-like consistency can be considered as appropriate material for experimentation. This includes:

- Cotton, Jute, Hemp, Straw
- Gladiolas leaves, Bamboo leaves and twigs, Coarse grasses
- Banana stem, Cabbage stumps, Corn stalks, Sugarcane
- Hibiscus, Mulberry, Flax, Nettles, etc.

(b) Identification:
The part of the plant which can be used for making paper is identified according to its fibre type in the following manner:

- Fruit Seed Hair - Example: Cotton.
- Bast / Inner Bark / Phloem - Example: banana, hemp, jute, flax.
- Leaf - Example: Bamboo, Gladiolas.
- Grass - Example: Sedge, Reeds.
- Stem Structure - Example: Bamboo, Mulberry.

(c) Preparation:

Once the raw material is gathered, workable parts are separated either by stripping or by decorticating or by removing outer bark and core. Selected parts are then soaked in plain water for overnight in plastic container.

For boiling transfer wet stuff in a stainless steel container and pour water to cover that.

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Preparation of material happens in 2 stages:

- Application of Alkali:
- The pH scale:

• Application of Alkali:
Alkali removes impurities from fibre and also looses the fibre structure. Percentage of alkali depends upon the strength of the fibre.

Alkali chart for use with fibres for papermaking:

- 10 grams of caustic in 1 litre of neutral pH water equals 1% solution.
- 15 grams of caustic in 1 litre of neutral pH water equals 1.5% solution.
- 20 grams of caustic in 1 litre of neutral pH water equals 2% solution.

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• **The pH scale:**
The pH (potent of hydrogen) scale is used to determine the acidity and alkalinity of a substance. The numbers of the scale range from 0 (strong acid) to 14 (strong alkali) with 7 being neutral.

For hard / tough fibre (like bark of a tree) use 2% solution. For medium strength fibre (like hemp, jute) use 1.5% solution. For soft fibre (like banana, leaves, rushes) use 1% solution of caustic soda (sodium hydroxide). Always mix caustic soda in cold water. Be advised that caustic can cause skin irritation. Rubber gloves, aprons and a well-ventilated room is strongly recommended.

Pour caustic solution in that stainless steel container and cook the plant for 2-4 hours. Wash cooked fibre in running water until it shows pH7.

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(d) Beating:
By now the vegetable material is a pulpy mass with a somewhat slick and fatty appearance. Much of the unwanted dirt and lignin (an organic substance which acts as a binder for the plant material) has been separated from the crude pulp. Cut the pulpy mass in small pieces and beat them either in hand grinder (kitchen mixer / grinder) or in Hollander beater. In another way, shortened pieces of pulpy mass are placed on a wooden plank and are pounded with heavy pestle or mallet to separate the fibre.

(e) Formation:
The pulp is now poured in a tub or vat and water is added to give proper consistency for forming the sheet on the hand mold. The mold is placed inside a deckle.

Mold is the chief tool for making handmade paper. It is a wooden frame on which the pulp is drawn from a tub or vat. The frame is covered with a metal (copper or stainless steel) or nylon mesh. There are two types of Mold:

- Wove Mold
- Laid Mold

The screen on a mold which contains wire sewn transversely is called wove mold. Paper formed on wove mold evinces no lines. The screen on a mold having a pattern of more widely spaced longitudinal wires held together with smaller transverse wires, called a laid mold. The mold pattern imprints itself on the finished sheet of paper.

Deckle is a wooden frame that fits over a mold while a sheet of paper is being formed. The deckle prevents the paper pulp from overflowing the mold.

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The papermaker dips the mold and deckle into a vat containing liquid substance (called half stuff). Before this dipping process the watery substance of the vat must be thoroughly stirred either by hand or by a stick in order to prevent the deposition of pulp in the bottom of the vat. When the mold and deckle are scooped up from vat, the surface of the mold is coated with a thin film of fibre-water mixture. The device is then shaken forward and backward and from side to side. This shaking has two effects; it distributes the mixture evenly on the surface of the mold and causes the individual fibres to interlock with the adjacent, giving strength to the sheet. While the device is being shaken, much of the water from the mixture drains out through the mold mesh. The device, with its formed sheet of wet paper, is then laid aside until the paper is sufficiently cohesive to permit the removal of the deckle.

(f) Pressing:

After the deckle has been taken from the mold, the mold is turned over and the sheet of paper is laid smoothly on a felt (woven woolen cloth). Another felt is laid over the sheet of paper, and the process is repeated. The process of placing the paper between two felts is known as couching. When a number of sheets of paper have been interleaved with felts, the entire pile, called a post, is placed in a hydraulic press and subjected to pressure of 100 or more tons, expelling most of the water remaining in the paper. Sufficient pressure is required so that the fibres are matted well enough to allow of the paper from the felt.

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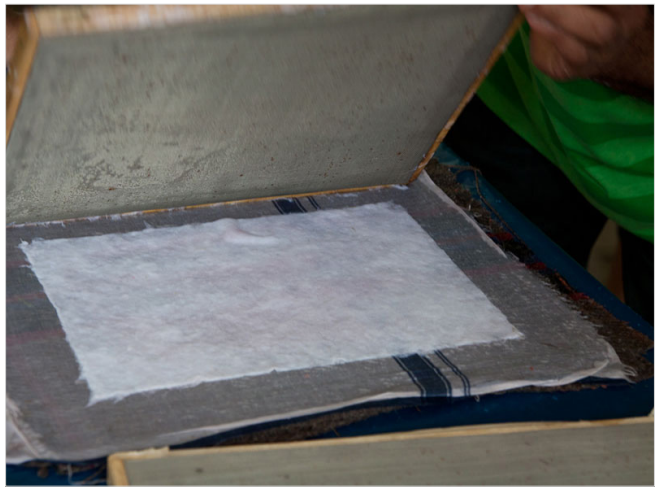

(g) Drying:
The paper can now be placed in between blotting papers or can be hung for drying in shadow until its moisture has almost completely evaporated.

(h) Sizing:
Sizing is a solution used to make the paper moisture resistant in varying degrees. Size can be added at two stages of the papermaking process. The degree of sizing of paper determines their resistance to the penetration of moisture.

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There are two types of Sizing :

- Internal/engine/beater sizing
- Tub sizing

The former describes moisture resistant pulps which receive sizing treatment in the beater. This sizing is especially useful when pulps are used for paper casting. Neutral Rosin or Alkaline ketene dimmer (AKD) or methyl cellulose (CMC – carboxyl methyl cellulose) is generally used as internal sizing. Tub sizing is acquired by passing through the dried paper into a solution of gelatin (or other size), contained in a bath or tub. The wet paper again has to be dried by previous manner.

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3D Sculptural Form

Sand moulds are also used in creating 3 Dimensional forms from the handmade papers. A sand mould is created with cloth and sand. Desired structure is drawn on a folded piece of cloth so that when cut together it gives two pieces of similar sized clothes whose outlines can be stitched to create a pocket. Sand is filled into this pocket which gives a protruded 3 dimensional structures.

The handmade paper in its wet state is wrapped around the sand mould and kept for drying. When it dries, the sand is taken out from the mould by cutting or piercing the cloth. The paper takes the shape of the mould when it gets dried. Different shapes and structures can be attained with this method.

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Handmade Paper Making

Understanding the Art by Creative Exploration

by
Mr. Anupam Chakraborty
DoD, IIT Guwahati

Source:
https://www.dsource.in/course/handmade-paper-making/3d-sculptural-form

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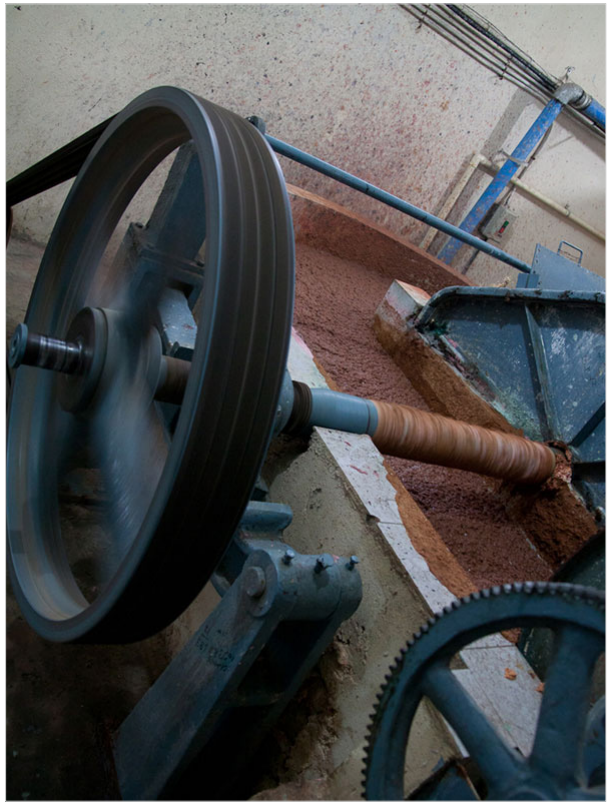

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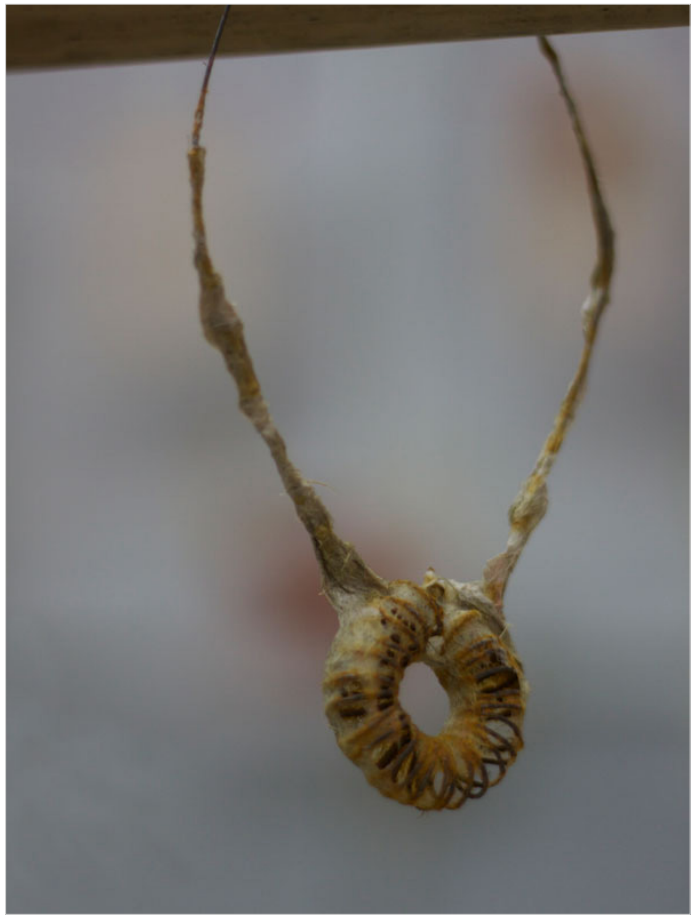

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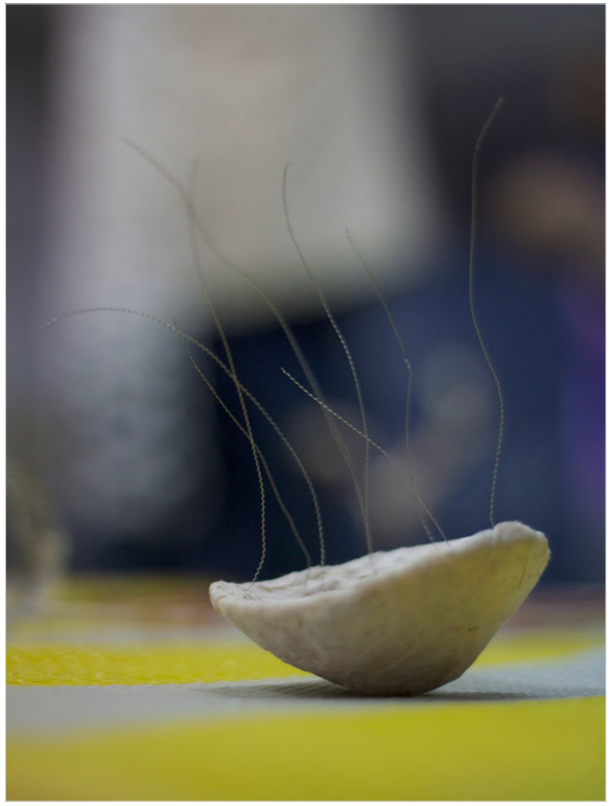

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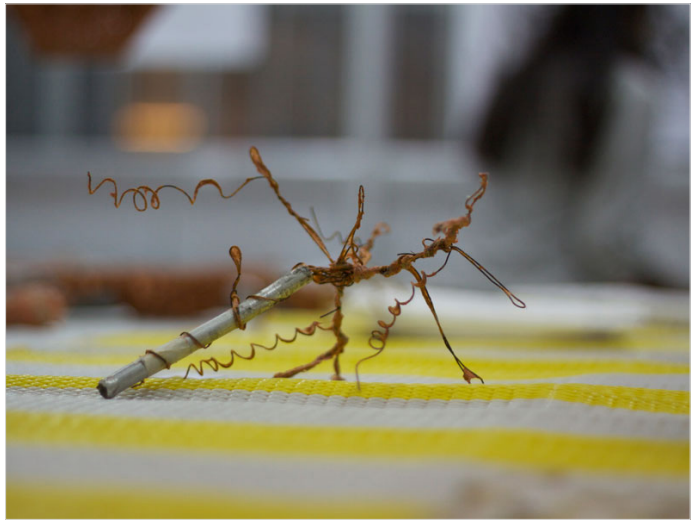

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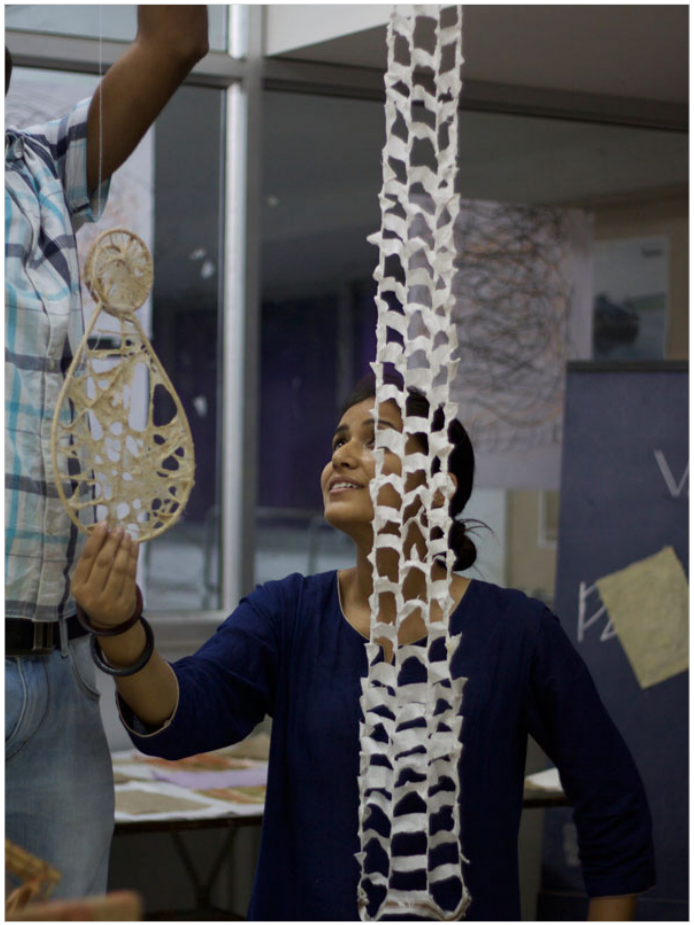

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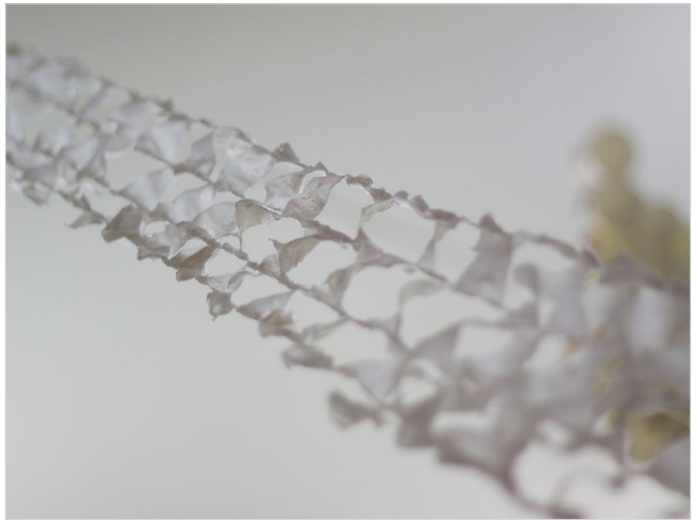

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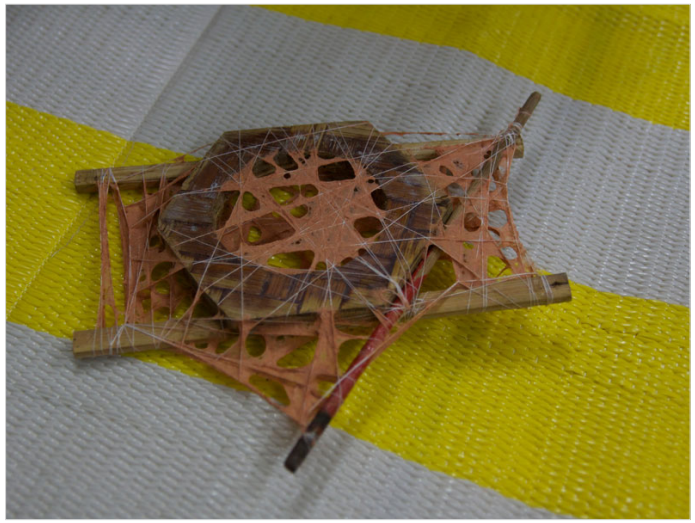

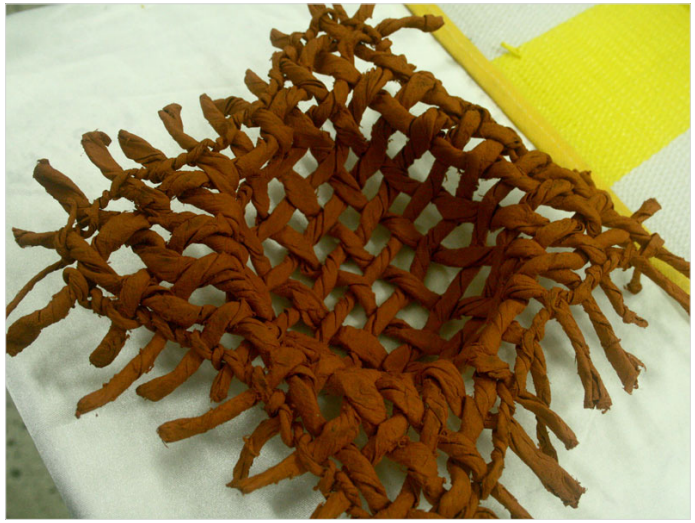

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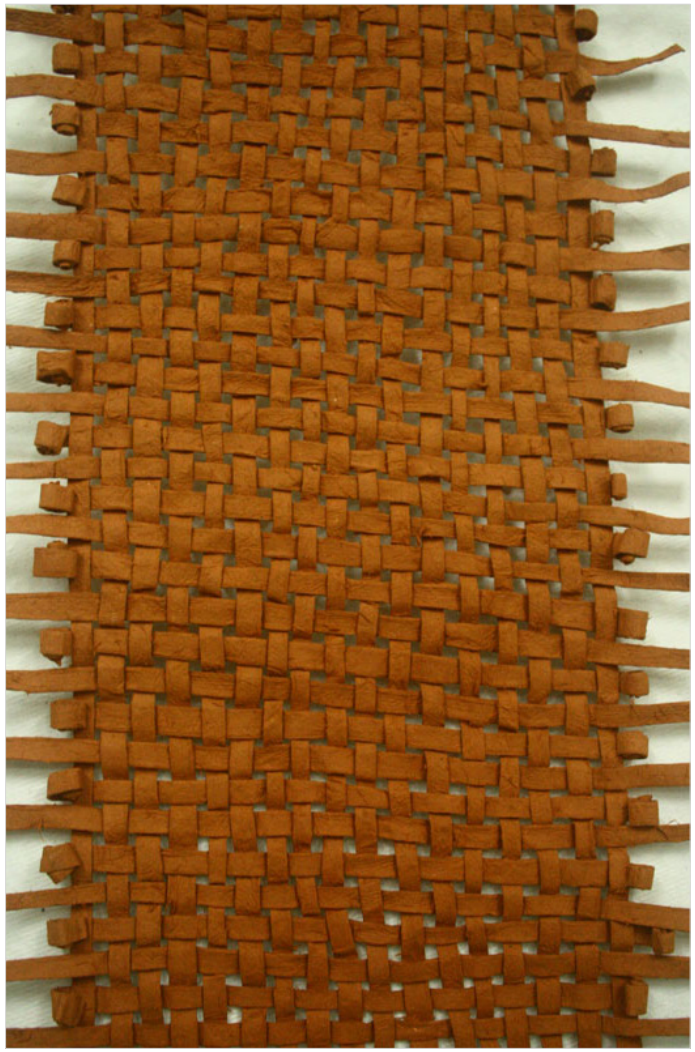

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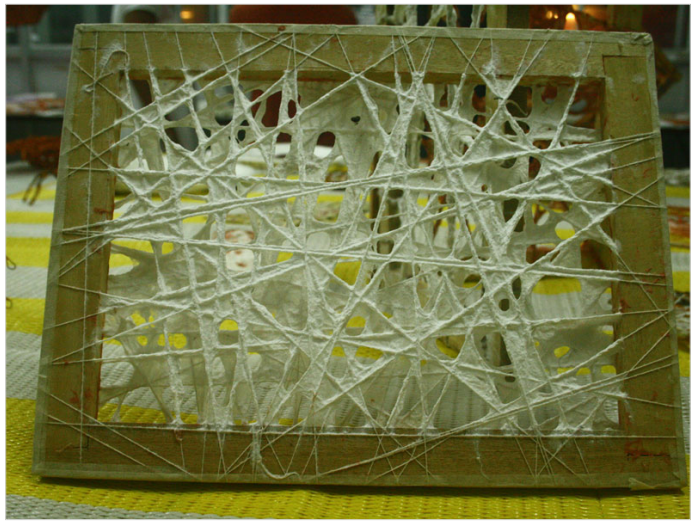

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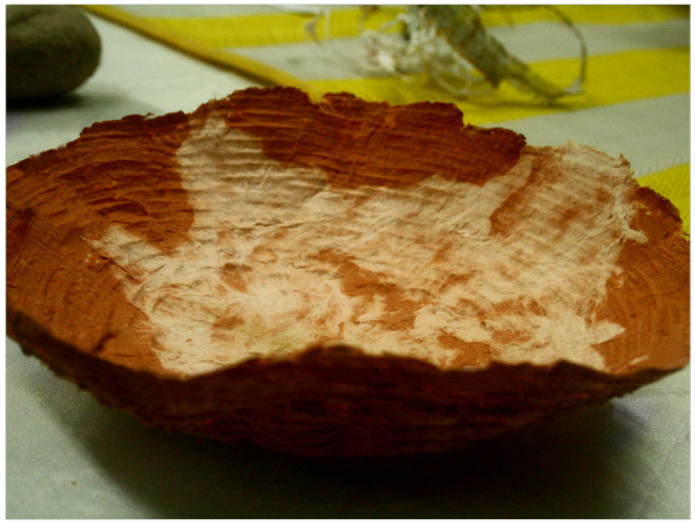

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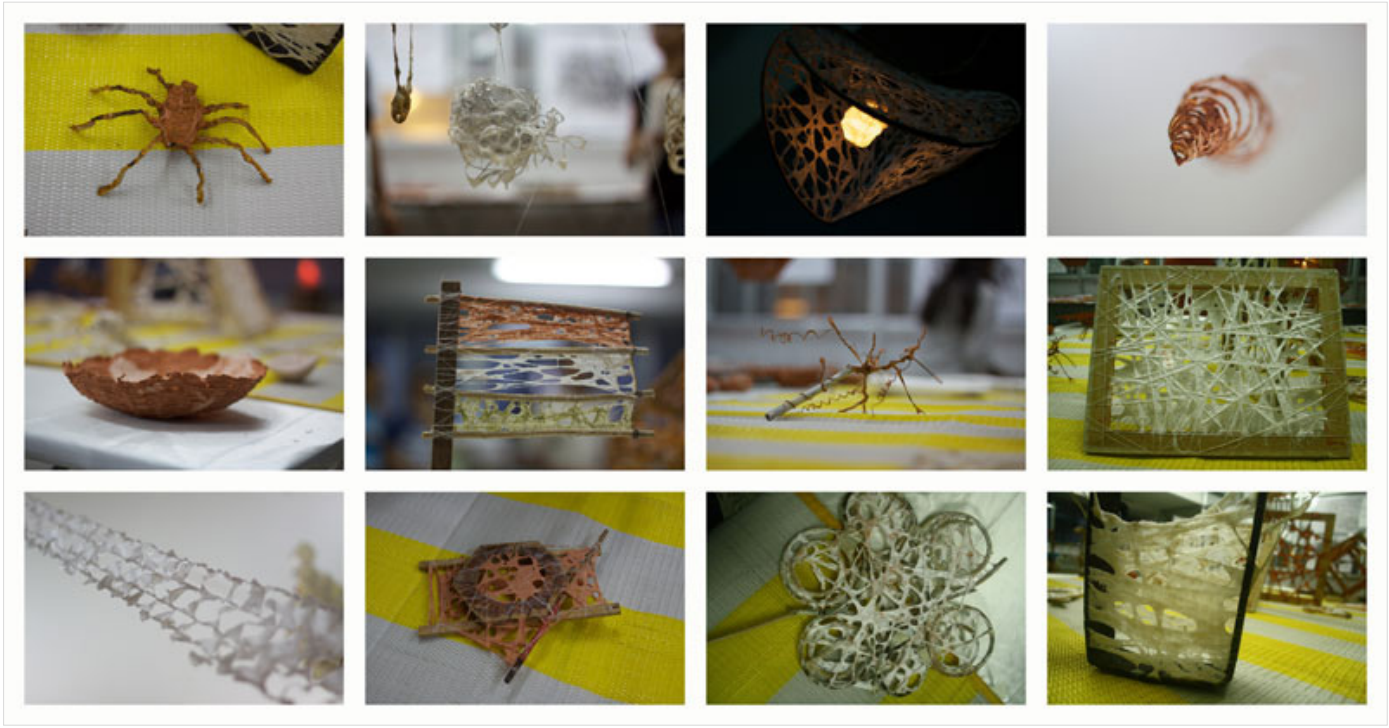

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Glossary

Acid Free:
Paper that is free from any acid content or other substance likely to have a detrimental effect on the paper or its longevity.

Alum:
A complex salt, most commonly aluminum sulphate added with rosin to pulp while it is in a beater as a sizing agent to impart a harder and more-resistant surface to the finished sheet. It also acts as a preservative and a mordant for fixing colours.

Archival Paper:
A paper with long-lasting qualities, acid free, lignin free, usually with good colour retention.

Bast Fibre:
The inner bark of such plants as banana, flax, hemp, ramie which when separated out from the outer bark provides fibres suitable for papermaking

Beater:
A machine which alters or modifies the properties of fibre.

Bleach:
A chemical used to whiten paper pulp, a solution of chlorine or similar chemical. Usually, hydrogen peroxide or bleaching power is used as bleaching agent.

Brittleness:
The property of paper to crack or break when bent or embossed.

Brightness:
Paper's ability to reflect white light. Titanium dioxide mainly used to add brightness and opacity to paper.

Buffering Agent:
It is an alkaline substance, usually calcium carbonate or magnesium carbonate, purposely added by the papermaker to protect the paper from acidity in the environment.

Calendaring:
A pressing process used to smooth or glaze a sheet of paper during the finishing process.

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Cellulose:
The main part of the cell wall of a plant.

Cotton Fibre /Linters /Rags:
The soft white filaments attached to the seeds of the cotton plant. Cotton fabric is made from long fibres removed from the seeds by ginning operation. Short fibres called linters, unsuitable for cloth but good for papermaking, are left. There are three grades of cotton fibres used in the papermaking process – first cut or lint; mill cut and second cut. Cotton is the purest form of cellulose produced in nature and it requires the least amount of processing before it can be used. Pulp can be produced from either cotton linter or rags.

Couch:
The action of transferring a wet sheet of paper from the mold onto damp felt.

Deckle:
A wooden frame that fits over a paper mould to prevent the pulp from running off the edges. It is also establishes the size of a handmade sheet during making.

Deckle Edges:
The wavy, feathered or ragged edges of a sheet of handmade paper on four sides caused by the deckle frame where pulp thins towards the edges of the mould.

Dyes:
A water-soluble colouring agent which usually penetrates and become attached to the fibre. Types of dyes include: direct dyes, fibre-reactive dyes, that form a chemical bond with the fibres; and natural dyes, derived from natural sources such as pomegranate skin, onion skin, henna tops, marigold flower, dry tea leaves etc.

Fibres:
The basis of a sheet of paper.

Fourdrinier:
The name of a type of paper machine in which paper is made at high speed in continuous web – machine made paper.

Gelatin:
A type of size obtained from animal tissues applied to the surface of paper to make it impervious to water and to aid resistance to bleeding during printing. Also imparts surface strength to watercolour and drawing papers.

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gsm / gm^2:
Unit of measuring paper weight. It means grams per square metre.

Hollander:
The paper beating machine that was invented in Holland.

Laid Mould:
A wooden frame for the forming of pulp into sheets of paper in which the characteristic of closely spaced parallel lines (can be seen in dry paper when it is held up to light) held in place by wire worked in the perpendicular direction to the strips.

Lignin:
The fibre bonding material found mainly in woody plant. It rejects water and resists bonding and therefore must be removed from the fibres before the paper making process.

Mould:
The basic tool of a Western hand papermaking which consists of a wooden frame and removal deckle.

pH:
The pH value is a measure of the strength of the acidity or alkalinity of a paper. The pH scale runs from 0 to 14. 7pH represents a balance between the acid and alkaline components and is a neutral solution. Above 7pH indicates more alkalinity and below 7pH indicates more acidic.

Pulp:
The 'stuff' used in papermaking process.

Ream:
500 sheets of paper.

Rosin:
One of the most commonly used internal sizing agent for paper. It is acidic in nature and detrimental to the permanence of paper.

Sizing:
A solution used to make the paper moisture resistant in varying degrees. Size can be added at two stages of the papermaking process. The degree of sizing of paper determines their resistance to the penetration of moisture. Internal sizing / Engine sizing / Beater sizing describes moisture resistant pulps which receive sizing treatment

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Handmade Paper Making

Understanding the Art by Creative Exploration

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DoD, IIT Guwahati

Source:
https://www.dsource.in/course/handmade-paper-making/glossary

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in the beater. Tub sizing – after manufacture, when the paper has been dried, some papers are passed through a solution of gelatine (or other size) contained in a trey or tub. Other surface sizes include casein and starch.

Vat:
A tub that holds the wet pulp.

Vellum:
The prepared inner side of calfskin; the term vellum can be used as an imitation of this type of surface in another paper.

Waterleaf:
Used to describe a paper that contains no sizing and is generally very absorbent, like blotting paper.

Watermark:
It is a translucent marking made in paper, barely noticeable except when the sheet is held up against the light or is placed against respective contrast background. The design is generally formed out of copper wire and attached as a mirror image to the flat surface of the mold. Where the watermark device is attached to the screen of the mold a raised surface occurs, because the actual quantity of pulp is less over the raised part than over the rest of the sheet. When the paper gets dried the design appears as a slightly thinner layer of paper.

Wove Mould:
A mould in which the covering screen is made by woven wire (similar to warp and weft in a cloth). Opposite to laid mould.

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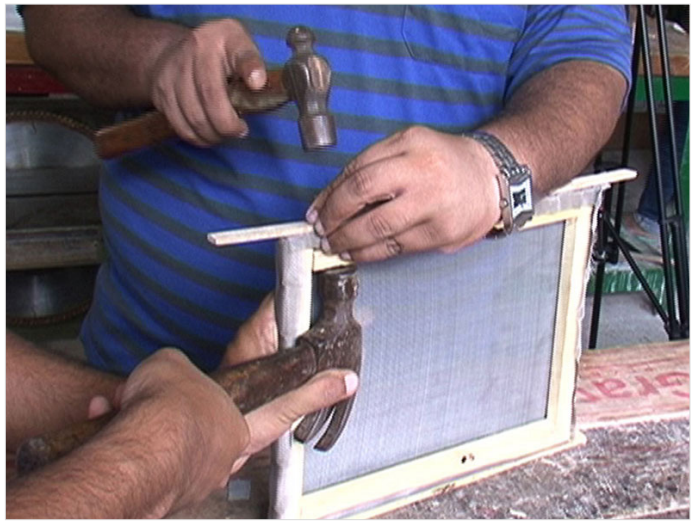

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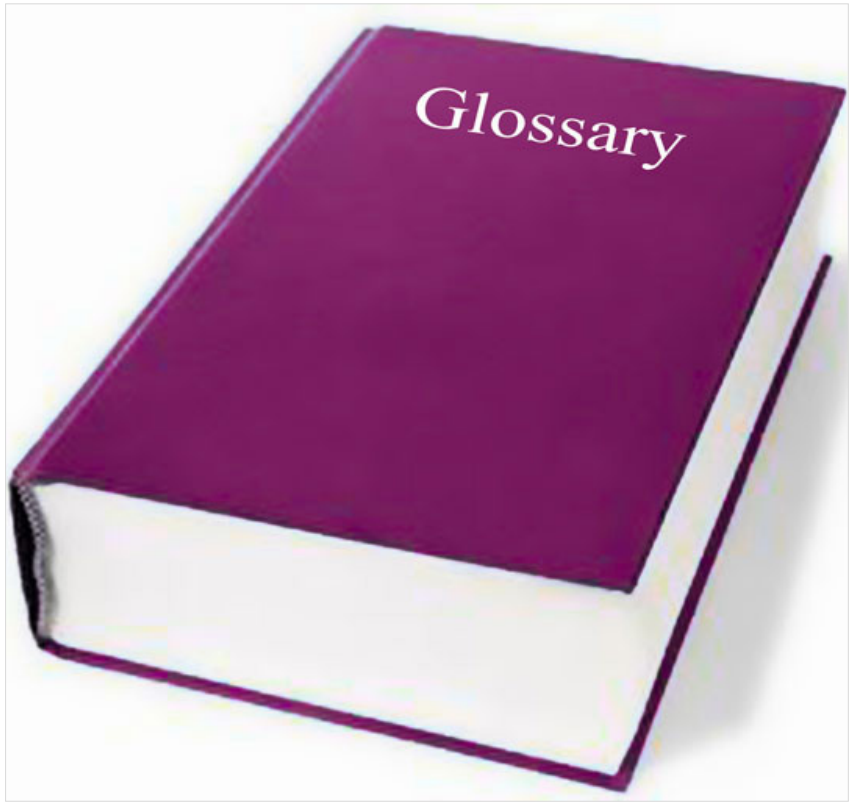

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Book and References

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Helen Hiebert	The Papermaker's Companion	Storey Publishing
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Arnold Grummer	Easy papermaking	
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James Rumford	The Cloudmakers	

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Book Binding - Book List:

Author	Name of the Book
Paulette Johnson	Creative Bookbinding
Peter and Donna Thomas	More Making Books by Hand
Keith A. Smith	The New Structure of the Visual Book
Keith A. Smith	Non-Adhesive Binding – Books Without paste or Glue
Keith A. Smith	Non-Adhesive Binding, Vol. II: 1-2-&3-Section Sewing
Keith A. Smith	Non-Adhesive Binding, Vol. III: Exposed Spine Sewings
Keith A. Smith	Non-Adhesive Binding, Vol. IV: Smith's Sewing Single Sheets
Keith A. Smith	Text in the Book Format
Diane Maurer-Mathison	The Art of Paste Papers
David A. Carter & James Diaz	The Elements of Pop-Up
Kathleen Trenchard	Mexican Papercutting
Carol Barton	The Pocket Paper Engineer
Diane Maurer-Mathison	The Ultimate Marbling Handbook

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Creative Exploration

3D Sculptural Form

Paper Making Workshop-1

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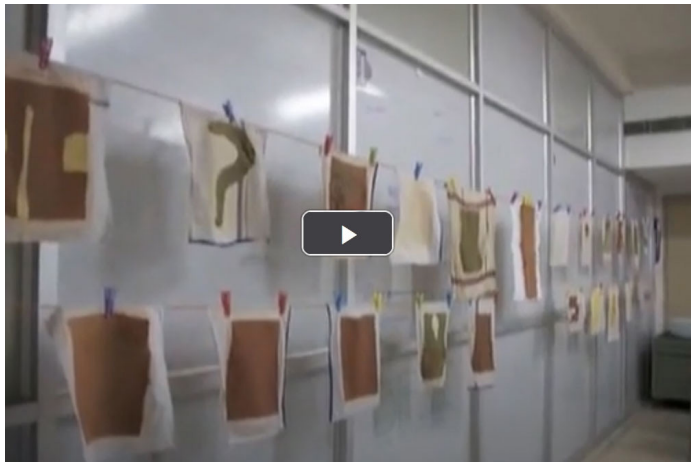

Paper Making Workshop-2

Source:
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This documentation was done at the Department of Design, IIT Guwahati on the occasion of "One week workshop on handmade papermaking" co-ordinated by Dr. Udaya Kumar, Faculty at DoD, IIT Guwahati.

The workshop was held under the guidance of Mr. Anupam Chakraborty, Director, Anupam Academy, Kolkata in December, 2011.

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